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The Tech Engineering News

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THE UNITED STATES NITRATE PLANT

MUSCLE SHOALS, ALABAMA

By W. B. WEST, Hydraulic Research Dept., M. I. T.

Soon after the outbreak of the war between the Central Powers of Europe and the United States of America the government officials realized that we were short on nitrate for explosives. Most of our nitrate is imported from Chile. It was, therefore, evident that, should our enemy in some way prevent us from receiving these chemicals, we should be very seriously handicapped.

For years Senator Bankhead of Alabama and others had advocated the construction of suitable locks and a dam across the Tennessee River near Florence and Sheffield, Ala., for the purpose of passing boats over Muscle Shoals at that point of the river.

So when it was seen that we must have a nitrate plant somewhere, the advocates of the Muscle Shoals project at once made their claims that the government do the entire job and use the hydro-electric power for the fixation of nitrogen from the air. After a very laudable fight for Muscle Shoals by Senators Underwood, Bankhead, and others, the Secretary of War finally decided in their favor.

FRACTIONAL COLUMNS U. S. NITRATE PLANT NO. 2

The War Department was also further authorized to construct a nitrate plant here for the manufacture of ammonium nitrate by the cyanimide process. This plant (No. 2) was to be operated by steam power until the dam could be completed which was expected to require some five years or more. The steam power plant will be an absolute necessity as an auxiliary to the hydro-electric plant. This nitrate plant together with the necessary steam power plant were completed at an approximate cost of $70,000,000. It is this plant—No. 2—which we shall endeavor to describe more or less in detail.

The power house is now completed. It is the very last word in power plant construction, being absolutely the most modern and up-to-date plant in the world. The 72,000 h. p. steam turbo-generator is one of the two largest units in the world. Steam goes into the high pressure end of this unit at a

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THE RELATION OF THE ARCHITECT TO THE ENGINEER

By W. H. KILHAM '89, Architect

Back in the hazy distance of the '80's when I was in Tech, the Architects and "Civils" occupied the two front rooms in the "new" building on the corner of Clarendon st. Although living side by side, and meeting now and then in sections as members of the Great Class we rather regarded each other as members, or rather children, of two entirely different professional families, whose paths, running at first parallel, would diverge more widely with the passage of time. The Civils, rather stern in the consciousness of their struggle with the intricacies of mathematics and "man's size" constructional problems, rather regarded the Architects as a weakly race, given to dabbling in water colors and pictures, while the Architects, from the heights of their lofty pursuit of the Ideal, were given to looking down on all inhabitants of the world in general who slighted the study of Art, or as the French would have it "Le Beau". The instructing staff doing its best to compress into three years a reasonable assimilation of the

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THE FEDERAL WATER POWER BILL

By H. K. BARROWS

M. I. T. '95

On Jan. 15th the "Federal Water Power Bill," as it is called, was passed by the Senate.

In its present form it has been considerably modified by amendments, as compared with the draft of the act as passed by the House on July 1, 1919.

The bill is now in conference between the House and Senate, for the purpose of drafting a compromise measure. The passage of this bill, when modified by further conference, will be an important step toward development of water power here in the United States, particularly on the public lands and reservations. Some of the more important features of the bill, as now written, are as follows:—

The Federal Power Commission which, briefly, is "To provide for the improvement of navigation, for the development of water power, and for the use of lands of the United States in relation thereto," is to consist of the Secretaries of War, Interior and Agriculture, and the work of the Commission is to be performed by and through the personnel of the three departments.

The Commission, in cooperation with the other executive departments and with state agencies, is to investigate the cost of water power development, its availability for market, and its fair value, in any region to be developed.

Licenses are to be issued to citizens, corporations, municipalities or states to construct, operate and maintain projects for the development and improvement of navigation and for the development, transmission and utilization of power (1) from or in any of the navigable waters of the United States, or (2) upon any part of the public lands and reservations, or (3) to utilize the surplus water or power from any government dam.

Navigable waters refer to the parts of streams or other bodies of water over which Congress has jurisdiction under its authority to regulate commerce with foreign nations and among the several states, this referring to rivers in either their natural or improved condition and,

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INDUSTRIAL GAS MASKS

By CLARENCE J. WEST
of ARTHUR D. LITTLE, Inc.

Before the late war, workmen about plants using processes in which acid or poisonous fumes are given off were forced to wear heavy oxygen helmets or such make-shift protection as moistened handkerchiefs and respirators filled with wet sponges. The work of the Chemical Warfare Service developed a gas mask, with fillings suitable for a variety of purposes, which is light, which can be put on in a few second's time and which requires little attention to keep it in good order.

It must be borne in mind, however, that the gas mask has certain limitations. While it is probably true that the Standard gas mask will offer almost complete protection under all conditions out of doors, the same mask may break down at once when used in a building, because of the higher concentration of gas. It is also true that the Standard mask, specially designed to protect against poison gases, offers little protection against the ordinary industrial gases, such as illuminating, natural, producer and blast furnace gas. Special canisters are required in these cases. The same is true of mine gases, where carbon monoxide is prevalent. Another limitation which must always be borne in mind is that the gas mask can never displace the oxygen helmet in atmospheres deficient in oxygen, or in atmospheres where there are large quantities of irrespirable or poisonous gases, such as in a gasoline tank.

It may be pointed out in passing that the canister of the mask plays the important part in this protection. The facepiece is simply an impermeable fabric which prevents the air-gas mixture from reaching the lungs except as it passes through the canister where the gas is removed.

THE BURRELL GAS MASK
Position When Not in Use

The industrial gases against which protection is considered necessary are: ammonia, chlorine, sulfur dioxide, carbon disulfide, sulfur chloride, oil fumes, hydrocyanic acid, carbon monoxide, and then a variety of gases and vapors in chemical plants.

The Bureau of Mines recognizes five classes of gas mask canisters or absorbent containers (Schedule 14):

Type A: For acid gases, such as carbon dioxide, chlorine, formic acid, hydrogen chloride, hydrogen cyanide, hydrogen sulfide, nitrogen peroxide, phosgene, and sulfur dioxide.

Type B: For organic vapors, such as acetone, alcohol, aniline, benzine, carbon bisulfide, carbon tetrachloride, chloroform, ether, formaldehyde, gasoline and petroleum distillates, toluene, and similar volatile compounds.

Type C: For ammonia.

Type D: For other special individual gases.

Type E: For dusts, chemical smokes, fumes, and mists, such as tin tetrachloride, silicon tetrachloride, titanium tetrachloride, and sulfur trioxide.

Type AB, AC, Etc.: For combinations of the preceding types.

The Bureau of Mines considers a gas mask permissible for use in air containing certain irrespirable gas or gases if all the details of construction and the chemical properties of the absorbent are the same in all respects as those of the gas masks that met the requirements and passed the inspections and tests of the Bureau of Mines.

CANISTER TESTS

Type A are acid gases. Tests are made at room temperature against 5000 parts per million (p. p. m.) of chlorine, 5000 p. p. m. of hydrocyanic acid, and 5000 p. p. m. of sulfur dioxide, at 50 per cent relative humidity, the gas flowing at the rate of 32 liters per minute.

Tested in this way, the life or service time of each canister must be at least 20 minutes. The end of the life will be the time at which a test shows 5 parts per million of chlorine, hydrocyanic acid, or sulfur dioxide in the air coming from the canisters.

Type B, organic vapors are tested against 5000 p. p. m. of carbon tetrachloride.

Type C are tested against 2% by volume of ammonia.

Type E are tested against tobacco smoke.

AMMONIA

The widest use for the gas mask thus far has been in connection with refrigeration plants, where ammonia is likely to be encountered. The ammonia plants are, as a rule, located in out of the way places that are frequently difficult of access and the engineer is usually helpless unless he has an efficient appliance that will enable him to reach the trouble and that will not encumber him in his work. The most important ammonia mask up to the army type was a large nickel plated metal, leather and rubber hood which fitted over the head and carried a compressed air tank in the back. The difficulty with such an apparatus was that it was never ready when needed.

Two ammonia respirators are at present available. One is manufactured by the Mine Safety Appliances Co. of Pitts-

THE BURRELL GAS MASK
Ready for "Gas"

burgh. The absorbent used consists of copper sulfate impregnated with pumice stone, as developed by the Chemical Warfare Service. Special care is taken to insure the proper amount of moisture, so that the absorbent is active, but at the same time to so limit the moisture that it will not be given off and fog the eye-pieces of the mask. Since 2% ammonia will burn the skin in about 5 minutes, tests are carried out against this concentration. In ordinary service, such as a canister is subjected to around an ice plant, a single canister will last from 4 to 5 months before it is exhausted. Since only a slight amount of ammonia passes through the canister when it starts to break down, sufficient warning is given the men to replace the canister with a fresh one.

The facepiece of this mask, which is typical of all manufactured by this company, is constructed of the highest grade heavy rubber, covered on the outside with a protective layer of tough elastic fabric. The broad flat surface rests easily against the face without binding action, and insures comfort to the wearer and freedom from leakage. The Tissot type of mask is used, in which the incoming air is drawn against the inside of the lens and keeps continually drying off any moisture that may tend to form. The connecting tube is made of the best grade of rubber covered with elastic fiber. It is attached to the canister by means of a special brass clamp insuring an absolutely tight connection and ease of canister replacement.

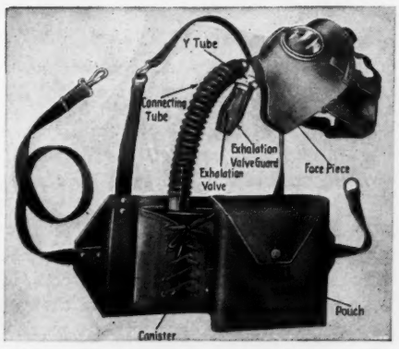
A similar mask (Kupramite) is manufactured by the American La France Fire Engine Company of Elmira, N. Y. They claim that this mask "gives complete protection an hour a day for eight days in ammonia fumes strong enough to burn the skin in five minutes." (2%).

CHARCOAL CANISTER

While in gas warfare a combination of charcoal and soda lime (war gas mixture) was necessary, it seems to have little use in the industry. The great majority of cases prefer a straight charcoal or soda lime canister.

The charcoal canister contains only a high grade activated charcoal (G. M. A. canister of the Mines Safety Appliance Co.) This is termed sixty minute charcoal and is the result of the further development of the 35 minute charcoal used in the army gas masks.*

The charcoal canister finds use in cleaning out tank cars, which were used in carrying all manner of organic liquids, for use around rubber plants, for protection against sulfur chloride, carbon disulfide, ether, chloroform and oil



THE BURRELL GAS MASK
Details of the Various Parts

fumes, and in lacquering plants for protecting the men when they apply the lacquer to metal parts, etc.

In certain cases protection may be desired against a mixture of ammonia with other gases. To furnish this, 50% activated charcoal and 50% ammonia absorbent is used (G. M. E. mask).

SODA LIME CANISTER

The straight soda lime (G. M. B.) canister should be used for acid gases, such as chlorine, sulfur dioxide, hydrocyanic acid, hydrogen sulfide, etc.

Among the uses to which the canister has already been put, the following may be mentioned: Smelting operations and paper mills, where sulfur dioxide is the principal gas encountered; chemical plants, where chlorine and other acid gases are found; salt mines, where accumulations of hydrogen sulfide may be found of sufficient concentration to affect the workmen; fumigation work through the West, in which hydrocyanic acid is used extensively; water purification plants, where chlorine is used. These canisters have an average life of from 2 to 3 months.

FIRE DEPARTMENT WORK

The war gas mixture plus a filter pad has been found very suitable for fire department work. The soda lime and charcoal mixture takes care of any gases (except illuminating gas), which might be encountered while the filter pad removes the fine smoke particles. These canisters enable fire fighters to penetrate to the seat of the fire without delay, to explore smoke filled rooms and to carry on their work unhampered. Cities like Pittsburgh, Chicago, St. Louis and Kansas City have equipped their firemen with the mask (G. M. C.—1).

A special smoke ammonia mask is manufactured by both of the companies mentioned above.

CARBON MONOXIDE CANISTER

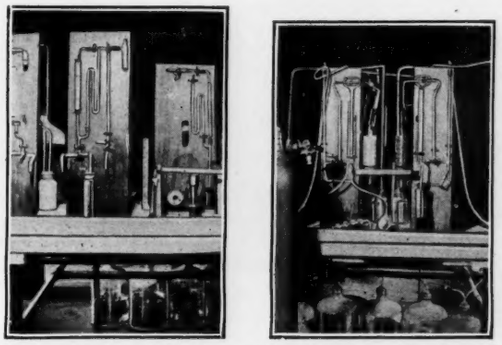
Carbon monoxide, because of its peculiar chemical nature, is a difficult gas to handle with a gas mask. Up to the time of the late war, no adequate means of protection had been furnished. Through the efforts of the Chemical Warfare Service, a material (Hopcalite) was developed, which acts catalytically in converting carbon monoxide into the harmless carbon dioxide. Hopcalite is a mixture of several metallic oxides, and is manufactured only by the Mines Safety Appliance Co.

This canister, of course, finds its use around blast furnaces, gas producers, smelters and other places where carbon monoxide exists in small quantities, and also in mine rescue work. A canister will give four hours of continuous or intermittent service. This time is usually more than sufficient to complete any one job when gas is met. In many cases the mask is needed only for short intervals at a time, and under such conditions is ideal equipment.

In this connection, it is interesting to note the M-S-A carbon monoxide indicator which has lately been placed on the market. This consists of a nickel barrel filled with a special gas absorbent for removing all gases likely to be present except carbon monoxide. By means of the rubber bulb a sample of the air to be tested is drawn through the barrel and forced through the small glass tube which is carried in clips on the top of the barrel.

This glass tube contains a specially prepared chemical (Hoolamite), which changes color in contact with carbon monoxide. This color ranges from a light green to a deep green depending upon the amount of carbon monoxide present and by referring to the color scale supplied with every instrument, the percentage of carbon monoxide present may be approximately determined.

This indicator may be used wherever carbon monoxide is likely to exist. It is positive in its action, extremely simple to operate, and strongly built throughout. It will probably replace the canary in the coal mines, because the indicator is as sensitive as the bird.



APPARATUS FOR TESTING GAS MASK CANISTERS

*A complete discussion of charcoal is given by Lamb, Wilson and Chaney, J. Ind. Eng. Chem. 11. 420-438 (1919).

See Lamb, Bray and Frazer, J. Ind. Eng. Chem. 12, 213-221 (Mar., 1920).

BRITISH AND AMERICAN SHIP-BUILDING

By JAMES ROBERTSON JACK
Professor of Naval Architecture

What is to be the future of American shipbuilding is a question of great interest at the moment, and those who are in the best position to judge are most reluctant to don the mantle of the prophet. A consideration of the position of British shipbuilding will help us to see the situation more clearly, though it will not suffice to answer the question finally.

Before the war British shipyards produced about as much merchant shipping as all the rest of the world put together. The Clyde alone could equal the whole output of Germany. While many of the yards undertook warship contracts, the great bulk of the work was for mercantile purposes, but when war was declared the Admiralty placed orders broadcast and these had precedence over all other work, and a transition occurred, so that by the end of 1914 merchant shipbuilding had almost ceased.

As the war progressed, Germany's surface ships were dominated and her submarines became the most important factor to be dealt with. To meet the shortage of tonnage both Britain and the United States made strenuous efforts, but the former having still large requirements for warships to fulfill could not spare men and material enough to supply her own needs and America easily became the principal builder of merchant shipping in the world.

Since the Armistice, the conditions have changed completely. Shortly after the ignominious surrender of the German fleet, the Admiralty canceled many of the warships which were under construction. The labor and material set free were immediately turned over to merchant work, first to re-condition ships which had been temporarily taken over for war purposes, and later to proceed with new ships which had been ordered during the war but could not be pushed forward till the fight was over.

The result is that the British output is rising rapidly and promises to return soon to its former magnitude. The emergency tonnage built in America, being to the order of a government department, naturally fell off after the termination of the war, and a good deal has been written of the matter in the technical press. Most of the writers who have deplored the fall of American as compared with British tonnage seem to overlook the fact that the British yards have been going "all out" for the last ten years, and that the war produced a change of kind, not of magnitude in the output. As an example, the yard of which I was manager turned out before the war about 30,000 tons of merchant shipping, and only about 2,000 tons of warships (destroyers) annually. From 1915 till the end of 1918 practically the whole output was for the Navy. Today the fighting ships are gone; the re-conditioning work is nearly completed and the whole resources of the yard are concentrated on merchant work as of yore.

That is typical of the whole industry, and the fact must be recognized. There is still room however, for a large American tonnage. While it is true that some of the American ships built during the war left a good deal to be desired, there were many fine vessels turned out and there is no question but that the United States has the men and the plants to do all that the most exacting can demand. The question narrows down to a commercial basis. Will it pay to own ships? The answer to that question will depend on government action. Under present conditions the cost of running ships under the American flag—especially in the Pacific—is such that private enterprise fights shy of it.

Now there is a very serious aspect, of national importance indeed, to this matter. Another war may occur: probably not in Europe. They "have had quite enough, thank you," but the Government of the United States is rightly taking no risk in the matter of the fighting fleet; that will be "all present and correct" when wanted. Wars may be conducted largely on the sea, but the final decision comes on land; the last word is with the infantryman.

When America joined in the grand finale of the war she had a fine big army, but no adequate transports to carry it to the seat of war, and she had to call on her ally Britain to provide the ships. John Bull was pretty busy, and he needed all his ships for transports and to bring food for his people who were feeling the pinch of some three and a half years of war. The situation was urgent, however, and the people were told they would have to face it, so they tightened up their belts a little more, had beef or mutton once, or perhaps twice, a week—never oftener—forgot the taste of luxuries like cream, and set themselves to hang on till the finish, so it was done.

Perhaps in the next war the United States will have her British kinsmen as allies and the British mercantile marine will be available for transport purposes. We all hope so, but the good relations existing between the two countries might be spoiled by unwise politicians on either side, and it does not appear wise to risk it.

Failing an adequate transport serv-

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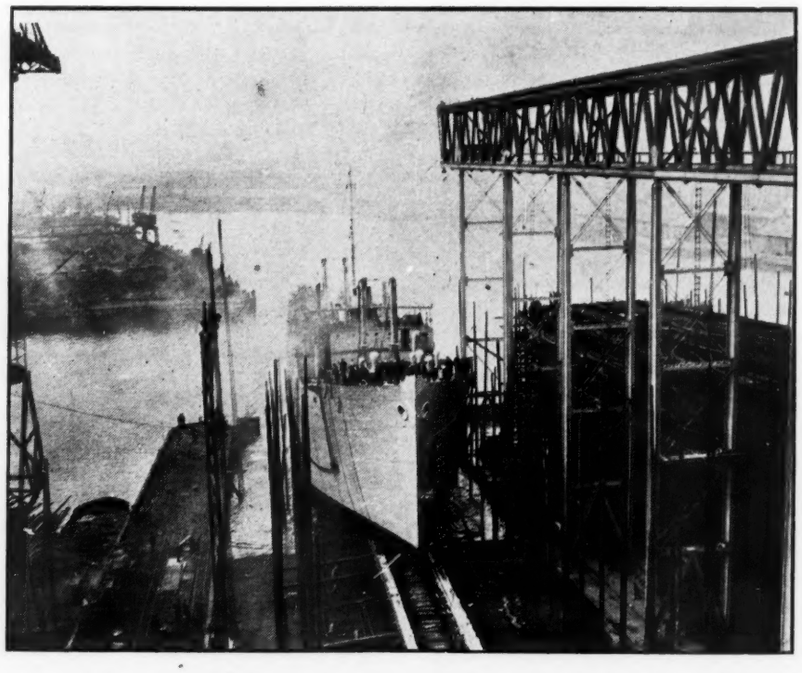

Courtesy of Underwood & Underwood.

LAUNCHING OF STANDARD BRITISH SHIP

THE WESTINGHOUSE GRADUATE STUDENT COURSE

By JOHN W. GUSTAVESON '18

The training graduates receive falls into the three distinct stages of shop work, testing and special schooling. In the first, whether segregated for design, application, commercial or works engineering, we pass rapidly through a number of shop manufacturing sections. The sections we go into, however, depend upon what type of work we have been segregated for. In my case, being in railway sales, I went from armature winding to electric locomotive assembly. From there to railway control wiring, and then switchboard wiring. After finishing switchboards I had two months in the machine works. At that time the machine works were still at East Pittsburgh; after June 1, 1920, we will be sent to South Philadelphia for the turbine work. We wear the garb of a workman and enter by the shop doors, observing shop hours. The shop hours are forty-eight a week—from 7 to 11:30 A. M. and 12:15 to 4:30 P. M. every day except Saturdays. Saturday they are from 7 to 11:15 A. M.

There are two reasons for this shop experience. As I have found in my own case, they are first, the mastering of details of both electrical and mechanical construction of apparatus and second, the contact which we get with the shop men and shop methods. Especially valuable is the ability of being able to get the workman's point of view and to get along with him. Getting along with men of few educational advantages and different points of view is quite a different matter from what we are accustomed to while at school. The workman has a fund of practical knowledge that is ours for the asking if we go after it in the right manner; but he becomes tighter than a clam if rubbed the wrong way. During the shop training essential structural features of Westinghouse are emphasized and comparison of competitors' apparatus is made in a series of conferences with engineers. The length of time spent in the manufacturing sections varies with the course, but seldom is it longer than six months. In my own case it has been seven months.

In the second phase of the work we do commercial and engineering testing on various types of machines. As construction is prominent in the first stage, the operating characteristics are featured in the test floor phase. This experience is also paralleled by group conferences with testing experts. Written reports of commercial and engineering tests are also required of all students. We have experience on different types of test work, my own being steam turbine, railway control apparatus, railway motor, and power apparatus. The length of the test floor training varies from three to six months depending upon the course. I was on the test floor three months.

The third phase of the training is a highly specialized work with more direct bearing on the position ahead. Special schools, varying in length from thirty to ninety days, consummate the several courses. A thirty-day commercial school for salesmen includes a course of advertising, company sales policy, commercial law, business English, business letter writing, salesmanship, business ethics and related subjects. For all these courses special textbooks have been devised, and the lectures are given by the company's leading men in the particular branch of the work they present.

For those of us who want to become designers and application men in the electrical field the engineering school provides a three months intensive training under the guidance of the chief engineer of the company. The outstanding features of the design of practically every standard piece of Westinghouse apparatus are considered in detail. The special aptitudes of those specializing in design are developed and each of us is studied thoroughly with a view to locating us to our best advantage in the engineering department. The designer is not a draftsman. The work in the school consists of but few lectures. Many reports are prepared by the group in order to develop the spirit of cooperation.

At the conclusion of our couses we automatically become members of the personnel of the department for which we have been trained. At the start I shall enter the East Pittsburgh office of the Railway Sales Department. After that it depends upon my own ability and efforts where I shall go and what I shall become.

This training that we receive represents an investment on the part of both the company and ourselves. This fact is a little hard to see at first, but it becomes clearer as our work progresses. While we are in training we are on a salary basis, but the amount we earn is considerably less than what we are paid. No doubt if we applied for a job as a mechanic we could soon be earning more than we are now paid. However that is not what we are in the shop for. We do not stay in a section long enough to become skilled. We are there to learn something of how the particular machine is built. Also the time we are attending conferences and school is all overhead expense. This is the company's investment in us. Our investment is simply the extension of a year of our time already invested, gaining the practical knowledge necessary to our best use of our education. For four years we have invested both time and money. Now we are investing our time. For our pay for the first year, which is $90 and $95 a month for the first and second six months respectively, will pay the living expenses of a single man in either Pittsburgh or Philadelphia.

Every effort is made to help us in our work. The Westinghouse Club located in Wilkinsburg, a residential section of Pittsburgh, offers an exceptional opportunity for development along educational, physical and social lines. It is a natural gathering place for the large number of technical men employed by the Westinghouse Electric and Manufacturing Company and affiliated interests. At the club are maintained technical sections providing additional lecture work on various lines of engineering, commercial and works management subjects. Inspection trips are run every Saturday to all the various industries located alround Pittsburgh. We are also invited to attend meetings of the numerous engineering societies. Athletics are not neglected. The club is largely supported by the company as dues for members are only nominal and all overhead expense of upkeep are carried by the company.

Wilkinsburg, situated midway between Pittsburgh and East Pittsburgh, where the shops are located, is the logical residence section for men in the company's employ. Practically all of the graduate students have their quarters there. Living conditions in Wilkinsburg are as good, if not better than the average. We all recognize that the crowded conditions which exist everywhere are due to the absence of construction during the war. Rooms are a little hard to find, but not as hard as in Boston and its suburbs. Transportation to Wilkinsburg is fair.

Several thousand men who have completed the graduate student course are in the service of the Westinghouse Electric and Manufacturing Company or some of its subsidiaries or interests. Many have entered the employ of concerns whose interests are closely identified with the success of the Westinghouse products, as for instance the various railway and interurban lines, which have been electrified, and central stations which have been equipped with Westinghouse apparatus. On the engineering staffs of many technical schools and universities, are men who amplified their technical training with practical experiece as graduate students with the Westinghouse Electric and Manufacturing Company.

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HOG ISLAND SMOKER

The professional societies are to be congratulated on the success of their combined Hog Island Smoker. They brought a big man to the Institute and so planned and executed the affair that the big man's big ideas forcibly reached a majority of the undergraduates. Technology is indeed fortunate to number such men as Matthew Brush among her alumni. The Hog Island Shipyard is the largest plant of its kind in the world. Shipping is produced there on a scale never attained elsewhere. The organization too, is remarkable. The whole yard was built and perfected in record time, and its production, from the first was unparalleled. All this means that new problems in engineering and administration were met, and that old problems were met in new and effective ways. Because of this, and because of the fact that this group of some of the country's greatest organizers will soon be broken up, Matthew Brush has had a series of lectures prepared, dealing with the Hog Island Shipyard. The University of Pennsylvania and Columbia University have asked to have these lectures delivered before their respective student bodies. But the series is offered to Technology. If Tech men show sufficient spirit and interest to warrant it, the lectures will be delivered here. The professional societies, acting together are taking the matter up. Failure will not result through any fault of theirs. The students also, seem to appreciate the fact that here is a remarkable opportunity. Their attendance at the Hog Island Smoker, coming as it did, in the final week of the term, was a revelation. If anything like the enthusiasm is shown at the proposed lectures, they will be a tremendous success, and the undergraduate body will receive the benefit of older men's experiences.

TECHNOLOGY ALUMNI

Matthew Brush, however is not the only Technology alumnus who can give valuable information to students. The 15,000 alumni of the Institute are, as a class, the professors, the technical experts, the business organizers of the country. To a man they will do all in their power to aid their alma mater. It has been amply demonstrated that whenever a call is made upon the alumni for service, they will respond enthusiastically. It is unfortunate perhaps, that they have not been called on more often. The faculty could gain much if the practical men were called in more frequently. In several courses now, business men and engineers are asked to lecture as a part of the regular work. A more general utilization of the ability and willingness of the alumni would work to the advantage of the undergraduates and also of the alumni in bringing them into closer touch with the men who are to follow them as the leaders of American Industry. Cooperation is the motto of today, and there is room for more of it between teachers and past pupils of the Intitute.

GREAT MEN OF TODAY

In our national development, our process of "growing up," we pass through various periods marked by various outstanding features of public opinion. One of these has been the tendency to glorify men with large possessions. All fame and honor has been granted to the man who "made his pile," the man who distinguished himself from his neighbors by his success in accumulating a disproportionate share of wealth, who astonished his neighbors with the abundance and elegance of his luxuries, fine houses, yachts, blooded horses, high powered automobiles. Many men have achieved success in this regard. There has been a wearisome array of very rich men in this country. The public has been sated with tales of their wealth and luxuries.

But standards have changed. The day when the wealthy man was the man most admired and respected is passing. To the child in the streets does the name of Rockefeller have a more familiar sound than that of Pershing? Is Edison or Guggenheim the better known man? To win distinction more is required of a man than mere accumulation of wealth. Frick and Carnegie perceived this. Rockefeller has come to the same conclusion, as is illustrated by his recent generous gift to hospitals and educational institutions. Distinction results, not from what a man does for himself, but from what he does for others.

It was a happy day for the nation when this began to be true. Every atom of credit for this substantial heightening of this nation's ideals is due to the great men who have perceived its need and put their beliefs into practice, to men like Henry Clay Frick and George Eastman. They are Americans to be proud of. Theirs is an example it is fitting for all of us to follow. Both arising from inconsiderable beginnings entirely through their own efforts and ability, they have placed the good of their fellow men above their own, have given force to the great principles of altruism.

A prominent trait of both these men is their modesty, a trait we should all do well to copy. So much propaganda has been distributed during the war that every one is tired of it. A man who boosts himself usually does it alone. His friends and acquaintances seeing that he is taking care of the job are likely to refrain from interfering. But the man of real merit who thinks only of the work at hand without diverting his attention to the thought of possible reward is not going to suffer for lack of publicity.

Great honor is due these men, who, although their gifts to deserving institutions have been greater in proportion to their wealth than those of any other rich men of this age, have always stipulated the utmost privacy, who have not cared to "have a fuss made over them." They are truly "men-rich," not rich men.

The United States Civil Service Commission announces that the Government is in need of a large number of draftsmen of various kinds. It is stated that fully 1,000 draftsmen were appointed in the Government service during the last calendar year. During this period of reconstruction technical men are especially needed. Besides draftsmen there are openings for surveyors and computers, also assistant and associate engineers, electrical, mechanical, civil, chemical, and ceramic.

Further information and application blanks may be obtained from the secretary of the U. S. Civil Service Board at Boston, New York, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, St. Louis, New Orleans, Seattle, or San Francisco, or from the U. S. Civil Service Commission, Washington, D. C.

THE RELATION OF THE ARCHITECT TO THE ENGINEER

Continued from Page 1

essentials of the two professions, had little time left for general professional topics, with the result that the graduates grew up without much conception of the desirability of a closer relation between Architecture, the art of ornamental building, and Engineering, by which I now mean all branches, Civil and all the rest, which with the more complicated nature of our requirements has become a vital necessity for most building projects.

As the complications of modern buildings increased, the architects, who at first were quite securely in control of the situation, met them by employing engineering specialists of all kinds as assistants, generally retaining the credit of authorship for themselves, but with the growth of great construction organizations, equipped to handle the designing and building of anything from a drydock to an apartment house, the engineering side forged more to the front until architects have begun to find themselves regarded as mere attaches, retained necessarily for the purpose of putting a "pretty front" on some building, but totally unnecessary for any other part of the work, while some large engineering firms have started "architectural" departments of their own, under the subdirection of an architecturally trained person who "needs the money" and is willing to sink his professional independence and who can produce a result which if not especially meritorious from the artistic point of view will at least satisfy the business men who are financing the project.

I believe that the present trend of ideas, as above outlined, is not leading to the best results for either side. Any large building operation needs the trained thought of both professions. The engineer with his patience, carefulness and systematic habits brings to the project qualities which should assure economical, or at least modern types of construction as far as the shell of the building is concerned, and the latest and most efficient devices for its equipment, while the architect can provide not only the artistic exterior but the habit of efficiently planning the subdivision of floor space, which is a part of his very life and is a quality in which he is still unsurpassed. Of course I am considering the perfect type in each case, and freely admit the regrettable existence of the hare-brained architect and the careless engineer, but I think everyone will admit the desirability of cultivating the types of temperaments which will produce not only the inventive and resourceful constructor but the idealistic designer, whose imagination, instead of being curbed, should be reasonably encouraged. In the days of Michael Angelo, these qualities were combined in a single individual, but the complications of this modern age seem to require the united efforts of at least two to produce even a comparable result, while bearing in mind that even in the time of the Renaissance, builders of Michael Angelo's type were not over plenty.

I spoke just now of the architect's training in planning. Thanks to the prevalence of the Beaux-Arts influence in most of our schools the careful study of the plan has been thoroughly inculcated in architects' minds and nothing is so abhorrent to the trained architect as a "loose" floor plan or a piece of evidently wasted space. This habit, furthered by practice in house planning, in which every square foot has to count, is what usually produces a shock in every well-regulated architect's mind when he enters the office or even the plant of the ordinary manufacturing concern and sees the areas of unused and costly floor space which are even now thrown away in some of these establishments where the engineer (sometimes a home-made one) has had full sway. The business man, above referred to, sometimes thinks that the "structure" is the most important thing about a building and he must place an engineer in control of the job so as to "get it right," forgetting that what he is really interested in is the completed result, and without an economical and at the same time attractive floor plan his building will be a financial failure, no matter how well constructed.

Therefore, I believe that to properly meet present conditions the ideal organization is one which combines the two professions on an equal footing, neither being the paid assistant of the other, but both working as partners to a common end, and I feel that in such a school as Technology, where both professions are taught side by side, the closest possible intercourse should be fostered, and the requirements of the two professions should be carefully explained by the instructing staff, perhaps in lectures at which students of the different courses would all be present.

In closing this little discourse, I should like to make the point that the perfect building must not only incorporate scientific construction, economical, healthful, and efficient planning, but the best possible aesthetic design, perfectly adapted to its present day purpose and free from fads and illogical adaptations of "period" work. The engineer who wastes floor space or makes an ugly elevation is no more open to criticism than the architect who, to save mental exertion, tries to utilize outworn and inappropriate motifs for the front of a twentieth-century building design by force of the logical French habit of thought, and it ought to be a matter of personal patriotism with every architect and engineer in the coming years to "show them" that America has outgrown its period of commercialism in building and is well on the road to higher things.

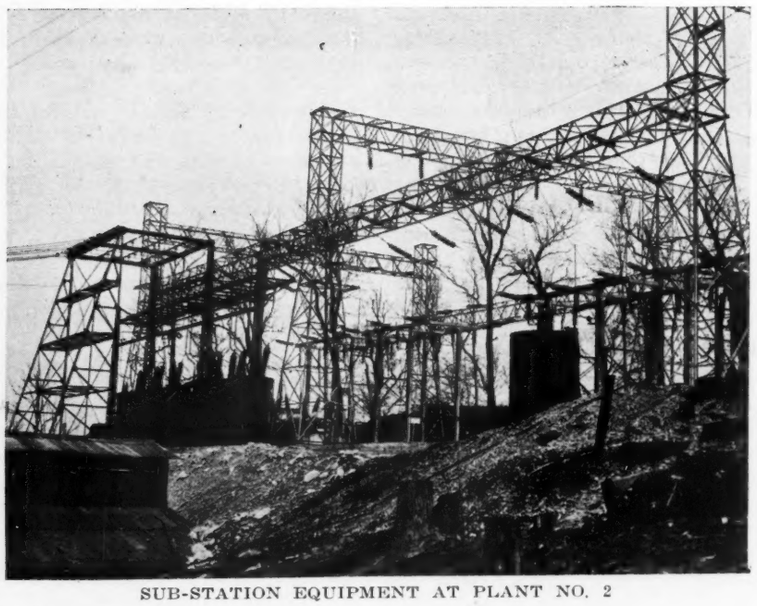
NEW YORK-NEW JERSEY VEHICULAR TUNNEL

Under the direction of Mr. Clifford M. Holland , the Interstate Commission's chief engineer, preliminary plans have been completed for the latest addition to New York City's system of underwater transportation, the New York-New Jersey vehicular tunnel under the Hudson. The construction of this long subsaqueous roadway for horse-drawn and motor-driven vehicles is of unusual interest because it is without an engineering precedent and involves problems of ventilation that call for most careful consideration. The well-known Rotherhithe tunnel under the Thames in London is of a similar nature, but has a length of only 1,570 ft. between ventilating shafts and is 2,230 ft. shorter than the proposed structure.

Considerations of cost and traffic congestion at each end have led the designers to adopt two tubes having a diameter of twenty-nine feet instead of a single double-decked one of larger capacity. They will be bored by the shield method, the cost of which increases nearly as the square of the diameter, and are intended to accommodate 65,000 vehicles daily. It is probable that the tunnel entrances on each side of the river will be located some distance apart, to avoid as much as possible the difficulties now encountered in the operation of the several East River bridges, which have never been used to full capacity because the approaches are inadequate for the converging traffic.

Until the Bureau of Mines thru its physiological tests has determined the quantities of carbon monoxide and other poisonous gasses likely to be given off by the motor vehicles, the method of ventilation is in doubt. The length of the tunnel and the volume of the traffic introduce factors that have not been met before; but a system wherein fresh air is forced in at the level of the roadway and foul air is drawn off thru ducts placed above the perforated ceiling seems to be the most feasible.

The project is expected to require three and a half years to complete. The cost is estimated at about $28,000,000, but conservative earnings ought to bring each state this sum in less than a dozen years. The present high cost of construction may delay the start on this great tunnel, but its obvious advantages in handling large volumes of traffic and its unquestionable value as a money-making proposition will eventually lead the two states to complete the undertaking.



SUB-STATION EQUIPMENT AT PLANT NO. 2

THE UNITED STATES NITRATE PLANT

Continued from Page 1

pressure of 275 lbs. per sq. in., the steam being first superheated. This section of the machine develops 26,666 h. p. The exhaust from here goes in both directions—east and west—to the low pressure sections at 50 lbs. per sq. in. Each of these low pressure sections develops 26,666 h. p. These machines are of the Westinghouse type. The machines supply power to nitrate plant No. 2 at a pressure of 12.200 volts over large bus bars of copper ¼"x4¼" sectional dimensions.

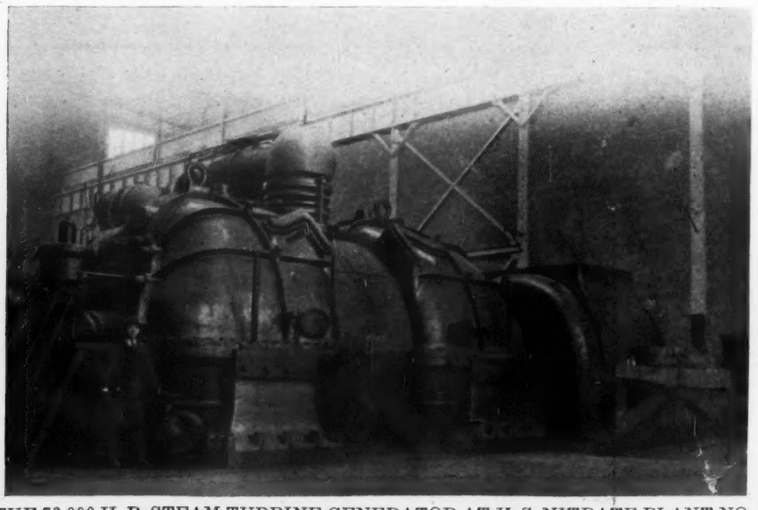
The engine room is served by a 60 ton electric crane. In the basement below the turbo-generators are the Westinghouse Leblanc Jet Condensers. The circulating pumps and other auxiliary equipment are also in the basement. There are four circulating pumps each capable of delivering 44,000 gallons of water per minute. Each is driven by a 500 h. p. electric motor. There are also four pumps each driven by an electric motor of 500 h. p. capable of delivering 10,000 gallons per minute from the river into the reservoir on top of the hill for domestic use after filtration.

Space is left at one end of the engine room for the further installation of another 40,000 h. p. steam turbo-generator. There are also two rotary type electrical condensers in the engine room. In the boiler room there are twelve 1500 h. p. B. & W. water tube boilers, each operating at a pressure of 275 lbs. per sq. in.

Concise Description of the Process For Manufacturing Ammonium Nitrate by the Cyanamide Process

There are five stages to the manufacture of ammonium nitrate, viz.:

1st. Making carbide from lime and coke.



THE 72,000 H. P. STEAM TURBINE GENERATOR AT U. S. NITRATE PLANT NO. 2

2nd. Making cyanamide or lime nitrogen from carbide and nitrogen.

3rd. Making ammonia gas from cyanamide or lime nitrogen.

4th. Making nitric acid from ammonia gas.

5th. Making ammonium nitrate from nitric acid and ammonia gas.

The processes of operation in this plant are as follows:

Carbide

1. In this plant lime is made by burning limestone in rotary kilns. In large electric furnaces this lime mixed with crushed coke is fused making carbide.

Cyanamide or Lime Nitrogen

2. The carbide is ground and heated by electric resistance carbons in air tight furnaces into which is pumped nitrogen gas, where the gas combines with the carbide under high temperature producing cyanamide or lime nitrogen. The nitrogen gas, which is used in making cyanamide is produced by compressing air into liquid air from which nitrogen gas is obtained by partial distillation.

Ammonia Gas

3. Agitating pulverized cyanamide under steam pressure in high pressure cylinders or autoclaves, a chemical reaction takes place producing ammonia gas.

Nitric Acid

Nitric oxide is made by passing over platinum catilyzers. From the oxidation plant the nitric oxide gases pass to a cooling building. After cooling, these gases are absorbed by water in absorption towers. Thence to weighing tanks.

Ammonium Nitrate

5. Bubbling ammonia gas through nitric acid, the ammonia gas neutralizes the nitric acid, producing a salt in solution. The water of this solution is boiled off and the residue is agitated while being dried, producing a crystallized salt, which is ammonium nitrate.

Ammonium nitrate is made from nitric acid and ammonia gas, the nitric acid is made from ammonia gas. Therefore ammonium nitrate is produced entirely from ammonia gas, so that ammonium nitrate is a gas in crystal form.

Five hundred exposures per second is the record in film photography made by two French scientists. They used electric sparks emitted by a special apparatus, and were able to take a detailed and accurate kinematograph record of the track of a revolver bullet. The cone of gas leaving the barrel before the bullet itself was clearly visible and the track of the bullet was clearly followed. Scientists forecast that this invention will enable accurate photographs to be taken of every form of movement in the human organism.

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To be admitted to the Institute, the applicant must have attained the age of seventeen years and must pass examinations in Algebra, Plane and Solid Geometry, Physics, History of the United States (or Ancient History), Trigonometry, English, French and German. Preparation in two of a series of elective subjects is also required. A division of these examinations between different examination periods is allowed. In general, a faithful student who has passed creditably through a good high school, having two years' study of French and German (or three years of French or German) should be able to pass the Institute examinations.

Graduates of colleges, and in general all applicants presenting certificates representing work done at other colleges, are excused from the usual entrance examinations and from any subjects already satisfactorily completed. Records of the College Entrance Examination Board, which holds examinations at many points throughout the country and in Europe, are also accepted for admission to the Institute.

Instruction is given by means of lectures and recitations, in connection with appropriate work in the laboratory, drawing-room or field. To this end, extensive laboratories of Chemistry, Physics, Biology, Mining, Mechanical Engineering, Applied Mechanics, and the Mechanic Arts have been thoroughly equipped, and unusual opportunities for field-work and for the examination of existing structures and industries have been secured. So far as is practicable, instruction is given personally to small sections rather than by lectures to large bodies of students.

The regular courses are of four years' duration, and lead to the degree of Bachelor of Science. In most courses the work may also be distributed over five years by students who prefer to do so. Special students are admitted to work for which they are qualified; and the degree of Master of Science, Doctor of Philosophy, and Doctor of Science are given for resident study subsequent to graduation. Opportunity for research is offered in all the departmental laboratories, in the three recently established Research Laboratories of Applied Chemistry and Physical Chemistry, and in the Sanitary Research Laboratory and Sewerage Experiment Station.

The tuition fee, not including breakage in the laboratories, is $250 a year ($300 next year and thereafter). In addition, $40 to $50 per year is required for books and drawing materials.

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THE FEDERAL WATERPOWER BILL

Continued from Page 1

(notwithstanding interruptions by falls or rapids), which are used or are suitable for transportation in interstate or foreign commerce.

Licenses under the act are to be issued for a period not exceeding 50 years, giving preference as far as practicable to states and municipalities in such applications. The annual license charges are to be fixed by the Commission in general proportion to the cost of supervision, but are not to exceed 25c. per developed horse-power. Where a license is benefited by construction work of another license or storage reservoir or headwater improvement of the United States, the license so benefited shall reimburse the owner of such reservoir for such part of the annual fixed charges as the Commission may deem equitable. If the license cannot acquire by contract or pledges the right to use or damage the lands or property of others necessary for a project under the act, this may be done by exercising the right of eminent domain in the United States District Court.

In time of war or public necessity, the United States may take possession of a project for use in manufacturing nitrates, and explosives, paying however fair compensation for the use of the property.

One of the prominent amendments by the Senate provides for the development of Great Falls on the Potomac River near Washington, with an appropriation of $25,000,000 for this purpose. It seems likely that this amendment will be struck out in conference as the Great Falls project involves a high and uncertain construction cost at present. Moreover, the Potomac is a "flashy" stream, with very low minimum flow, so that a large aux-

iliary steam plant would be necessary for dependable power output.

Another Senate amendment which is causing decided criticism is that which provides for the detail of an officer from the United States Engineer Corps to serve the Commission as Executive Secretary and Engineer Officer. This would give undue prominence to the Department of War in the operations of the Commission. Furthermore, it would limit very seriously the field from which the appointment of this official should be made. The work of this Commission will be of sufficient importance to warrant the best man obtainable for Executive Secretary and Engineer.

What will be the effect of this Act on water power development, assuming that this bill is finally passed with its main provisions as now written?

The total power of all kinds now developed in the the country is about 40 million h. p., of which about 1-5 or 8 million h. p. is water power. The potential undeveloped water power available as a minimum is about 30 million h. p., which however might warrant development up to perhaps 60 million h. p.

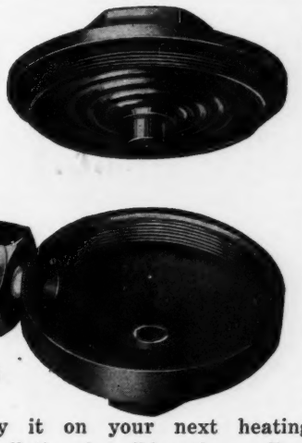
In geographical distribution however, which is most important in respect to utilization, 70 per cent of the developed water power is east of the Mississippi, while about 70 per cent of the undeveloped water power is west of the Mississippi and in fact nearly half of it is in the states of Washington, Oregon and California alone. This means that here in the East, steam power must continue to be largely utilized, although there are still many opportunities for water power development, which will doubtless soon be availed of under the stimulus of rising fuel and labor costs.

The extent of control by the new Federal Commission of navigable streams is the important feature in the East. The Connecticut River, for example, is navigable in its lower portions and is an interstate stream. Technically, storage and power developments on the upper main river as well as any tributary, affect this navigability. In fact there are few streams which are not navigable to some extent as defined by this Act.

We have been hampered in New England particularly by state laws restricting transmission of water power and a national agency of this kind may help make possible the "Super-power" plan now being advocated for the Atlantic coast region, whereby the transmission lines of some ten states would be interconnected and their power resources more generally utilized.

The control of the water power in the national forest lands will constitute perhaps the most important feature of the work of the new Commission. In 1915 about 56 per cent of the nearly 2 million

Continued on Page 14



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BRITISH AND AMERICAN SHIPBUILDING

Continued from Page 4

ice, the fighting line must lie, not on the enemy's soil, but on that of the United States, and that is to be avoided at all costs. After all, that cost need not be a high one. A well designed and organized mercantile marine even today would not be far from self-supporting. A little assistance from the government, such as would level up the difference between the highly paid American labor and the cheaper Asiatic, would absorb only a small fraction of the Navy appropriation, and whether it be considered from the military or the economic standpoint, the nation would receive good value for its money.

CORRECTION

In the article "Concrete in Wintertime," published in the March issue, it was stated that a temperature of 1500 F. is sufficient to heat sand and gravel. This should read 150° F.

ALUMNI COLUMN

F. K. Copeland '76, was recently elected president of the Western Society of Engineers, and is now actively engaged in a drive for membership that will make the society of national importance. Mr. Copeland is also president of the Sullivan Machinery Company, Chicago.

Clarence Goldsmith '98, has been placed in charge of the branch office recently opened in Chicago by the National Board of Fire Underwriters and in this capacity will supervise grading cities and towns throughout the middle west in reference to fire defences. At one time Goldsmith was assistant engineer in the City of Boston Public Works Department, connected with Fire Department Headquarters and for the last twelve years has been actively connected with the National Board as engineer. He held a commission as major in the Construction Division of the Army.

J. L. Hecht, '04, has entered upon his duties as vice-president of the Western Society of Engineers. He is at present connected with the Public Service Company of Northern Illinois, Chicago.

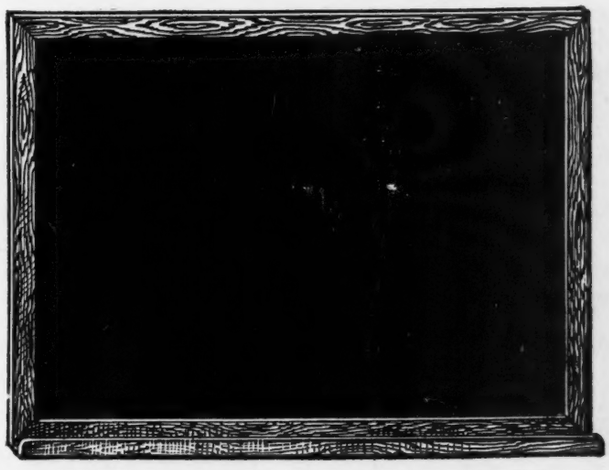
L. R. Chadwick, '06, for several years manager of the Spokane and Seattle branches of the Sullivan Machinery Company, has been appointed manager of the New York branch and will take up his duties at once.

M. M. Corey, '12, has resigned his position as general manager of the Gliddings, Lewis Manufacturing Company at Fond du Lac, Wisconsin, to take over his new interests. He was formerly sales engineer for the Concrete Steel Company, Chicago.

Kirk McFarlin, '14, was recently elected vice-president of the Hensey Company, New York. Since graduating he has been connected with the Hyde, McFarlin, Burke Company at Madison, New Jersey and the Barrett Company of New York.

G. H. Garcelon, '03, has recently been appointed manager of the Small Motor Engineering Department of the Westinghouse Electric & Manufacturing Company, with an office at East Pittsburgh. Immediately upon graduating, he entered the Graduate Student Course with the Westinghouse Company. A year later he entered the engineering department carrying on special development work on single phase induction motors.

C. J. Sittinger, '10, has been placed in charge of a branch office of the John A. Stevens Engineering Company at Lowell.



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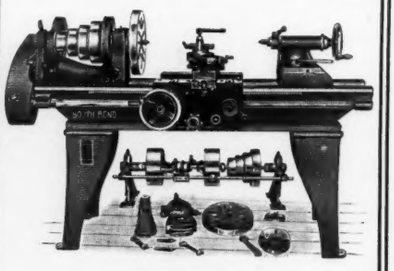

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FEDERAL WATER POWER BILL

Continued from Page 11

h. p. of developed water power in the western states was either located upon or directly dependent upon storage reservoirs constructed on these public lands. Practically one third of the undeveloped water power in these western states also lies within these lands, which as already noted, means therefore about 1-5 of the undeveloped water power of the whole country. An adequate law to provide in a suitable manner for development of these vast public resources has long been needed and will help greatly to attract capital for this purpose.

The use of water power at government dams—mostly built for navigation purposes, the third feature of the Act, is an item of much less importance in total power made available, but of substantial value in many cases where the power is within reach of a good market.

The "Federal Water Power Bill" if enacted will therefore be of great importance in the water power development of the West. In the remaining portions of the country, and particularly New England and the Atlantic States where power demands are the greatest, its effects can not be as definitely predicted, as so much will depend upon the breadth of interpretation of the control of navigable waters, as assumed by the Commission and developed by court decisions.

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Industrial expansion, however, has wrought many changes in power plant practice since 1887. Today mechanical stokers are called upon to burn anything from high-grade coals down to refuse. They are also called upon to meet the sudden and enormous steaming capacities. Hence, the additional stokers were added, and our line now includes the Chain Grate Stoker, particularly adapted to the burning of low-grade, high-ash fuels; and the Underfeed Stoker, which is unequalled in its ability to handle the sudden and enormous overload demands of central station service with the highest degree of efficiency.

It is a fact of vital importance to the stoker buyer that we manufacture the three general types, because stoker application should be approached with an open mind and the stoker manufacturer should be guided in his recommendations purely by the facts that develop from a study of fuel and load requirements.

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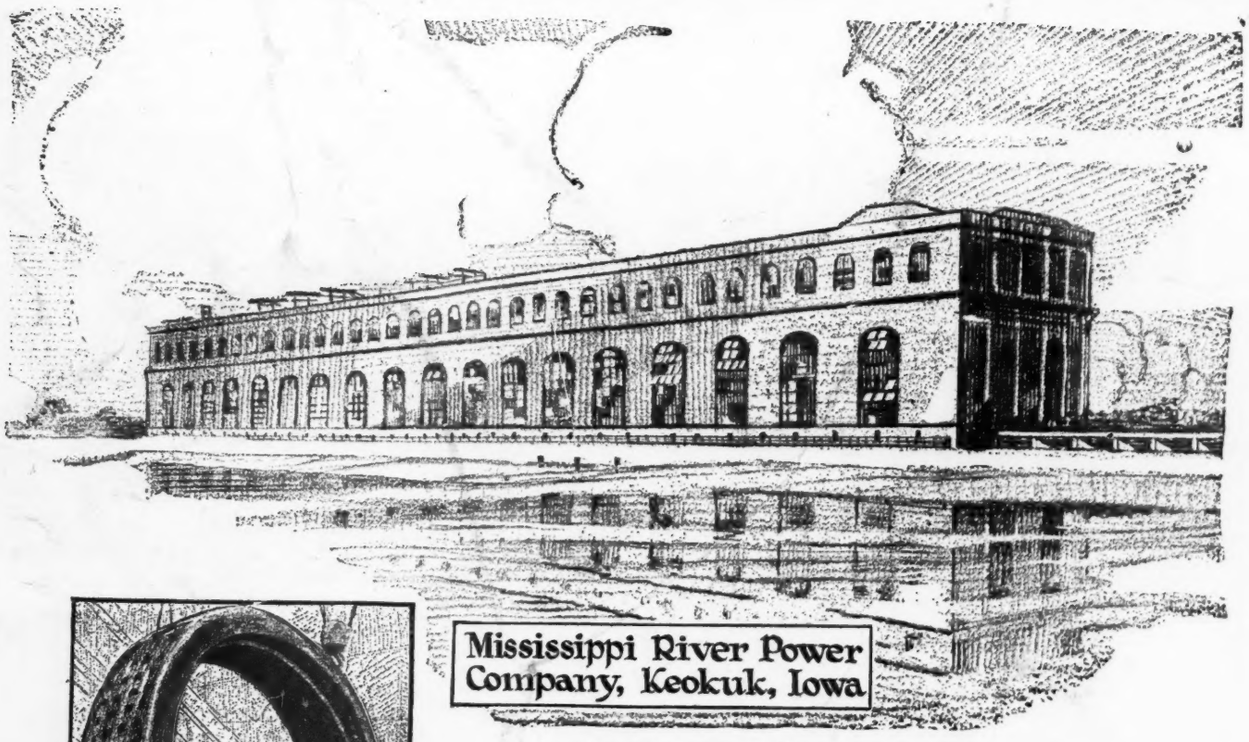
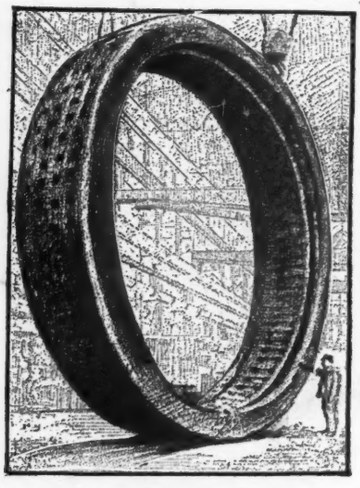


Mississippi River Power Company, Keokuk, Iowa



A casting for one of the huge water-wheel driven generators installed in the Mississippi River Power Company's plant at Keokuk. This installation will ultimately consist of thirty of these machines, giving a total capacity of 216,000 kilowatts (300,000 horsepower). It is the largest hydro-electric development in the world. The General Electric Company builds generators for water-wheel drive in sizes ranging from 37½ to 32,500 kilowatts and the aggregate capacity of G-E units now in successful operation is in excess of four million horsepower.

Utilizing Nature's Power

ELECTRICAL energy generated by water power has grown to be one of our greatest natural resources — and we have only begun to reach its possibilities. It mines and refines our ores, turns the wheels of industry, drives our street cars and lights our cities and towns. The power obtained from Nature saves many million tons of coal every year.

At first the field of its utilization was limited by the distance electricity could be transported. But soon research and engineering skill pointed the way to larger and better electrical apparatus necessary for high-voltage transmission. Then ingenious devices were invented to insure protection against lightning, short-circuits, etc., which cause damage and interrupt the service. And now all over the country a network of wires begins to appear, carrying the magic power.

The General Electric Company, with its many years' experience, has played a great part in hydro-electric development. By successfully co-ordinating the inventive genius of the company and its engineering and manufacturing abilities, it has accomplished some of the greatest achievements in the production and application of electrical energy.

The old mill wheel of yesterday has gone. Today the forces of immense volumes of water are harnessed and sent miles away to supply the needs of industry and business and the comforts of the home.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

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